Volume 10 February, 1924 Number 2

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

The Tractor

and

Its Lubrication

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

TEXACO TRACTOR LUBRICATION GUIDE

Showing the Correct Grades of Texaco Tractor Lubricants for the Various Types of Gasoline and Kerosene Driven Tractors

The letters opposite each name indicate the grade of Texaco Tractor Lubricants recommended. "B" indicates Texaco Tractor Oil "B." "C" indicates Texaco Tractoil "C." "D" indicates Texaco Tractoil "D." "H" indicates Texaco Motor Oil Heavy. "M" indicates Texaco Motor Oil Medium. "EH" indicates Texaco Motor Oil Extra Heavy.

MANUFACTURER	MODEL	TRADE NAME	Gasoline			Kerosene		
			Above Frost	Below Frost	Very Cold	Above Frost	Below Frost	Very Cold
Acme Cultivator Co.		Acme, Jr.	D	D	M	D	D	M
Advance-Rumely Thresher Co., Inc.	12-20, 16-30,	Oil Pull	C	D	H	C	D	H
	20-40, 30-60,	Oil Pull	B	C	H	B	C	H
	15-30	Aultman-Taylor	C	D	H	B	C	H
	22-45, 30-60	Aultman-Taylor	C	D	H	C	D	H
Agrimotor Mfg. Co.		*Midwest	EH	H	M	D	EH	H
Allis-Chalmers Mfg. Co.	6-12	General Purpose	D	D	M	D	D	M
Allis-Chalmers Mfg. Co.	15-25, 18-30, 20-35	Allis-Chalmers	C	D	H	B	C	H
American Farm Mchy. Co.	1½-3	Kinkade (Garden)	D	D	M	D	D	M
Andrews-Kinkade Tr. Co.	18-36	Andrews-Kinkade	C	C	H	B	C	H
Appleton Mfg. Co.	12-20	Appleton	C	D	H	B	C	H
Aro Tractor Co.	3-6	Aro	C	D	H	†	†	†
Atlantic Mach. & Mfg. Co.	2	Merry Garden	D	D	D	C	C	D
Automotive Corporation	12-24	*Automotive	C	D	H	B	C	H
Auto-Track Tractor Synd.	30-50	*Auto-Track	C	C	H	B	C	H
Avery Company	8*, 14*, 18*	Avery	C	C	H	B	C	H
Avery Company	12*, 25*, 40*, 45*	Avery	B	C	H	B	C	H
Avery Company		Single Row Cultivator	D	D	M	C	D	M
Avery Company	C	Two Row Cultivator	D	D	M	C	D	M
Avery Company		Track-Runner	C	D	H	B	C	H
Avery Company	15-30, 20-35	Avery	D	D	H	D	D	H
Avery Company	25-50, 45-65	Avery	C	D	H	B	C	H
Avery Company		Road-Razer	D	D	M	C	D	M
Bailor Cultivator Co.	6, 8	Bailor 1 & 2 Row Cultiv.	D	D	H	C	D	H
Bates Machine & Tractor Co.		Bates "25"	C	D	H	B	C	H
		Bates "40"	C	C	H	B	C	H
		Bates Model "F" & "G"	C	D	H	B	C	H
	15-25, 18-25, 30-40	Bates Steel Mule Models *H, *F, *40	C	D	H	B	C	H
Bean Spray Pump Co.		*Bean Trackpull	C	D	M	C	D	M
Bear Tracors, Inc.	25-35	Bear Model "B"	C	D	H	B	C	H
Beeman Tractor Co.	½-1	Beeman, Jr.	D	D	M	†	†	†
Beeman Tractor Co.	2-4	Beeman	C	D	H	†	†	†
Best, C. L., Tractor Co.	30	Tracklayer	C	C	H	B	C	H
Best, C. L., Tractor Co.	60	Tracklayer	B	C	H	B	C	H
Blumberg Motor Mfg. Co.	9-18, 12-24	Blumberg Steady Pull	D	D	H	D	D	H
Burn Oil Tractor Co.		*Burn Oil	‡	‡	‡	EH	H	H
Cameron Motors Corp.	10	Cameron	C	D	H	C	D	H
Case, J. I., Plow Works Co.	15-27	Wallis O. K. Case Motor Cultivator	C	D	M	C	D	M
Case, J. I., Threshing Machine Co.	12-20, 15-27, 22-40	Case	C	D	H	C	D	H
	40-72	Case	C	D	H	B	C	H
Central Tractor Co.	2½-5	Centaur	C	D	H	B	C	H
Clark Tructractor Co.		Tructractor	D	D	M	D	D	M
Cleveland Tractor Co.	9-16, 12-20	Cletrac	C	C	H	B	C	H
Commercial Machine Co.	2½	Comaco	D	D	M	D	D	M
Community Mfg. Co.	10-20	*Allen "A"	C	D	H	B	C	H
Dart Truck & Tractor Co.	12-25	Blue "J"	C	D	H	†	†	†
Dayton-Dowd Co.	12-18	Leader "B"	C	D	H	B	C	H
Dayton-Dowd Co.	16-32, 18-35	Leader "N", "GU"	C	C	H	B	C	H
Dayton-Dowd Co.	18-36	Leader "C"	D	D	H	D	D	H
Dill Tractor Mfg. Co.	26	Dill Harvesting	C	D	H	B	C	H
Dissinger, C.H.A., & Bro. Co.	15-30, 10-20, 25-45, 40-80	Capital	C	C	H	B	C	H
Dodge, H. C., Inc.	½-1	Sprywheel	C	C	H	†	†	†
E & W Co.	15	Durable	C	D	H	C	D	H
Eagle Mfg. Co.	16-30, 12-22	Eagle Model "H", "F"	C	D	H	B	C	H
Electric Wheel Co.	14-28, 16-30	All Work Mod. "C", "G"	C	D	H	B	C	H
Ellwood Tractor Co.	10-20	*Ellwood	C	D	H	B	C	H
Emerson-Brantingham Implement Co.	12-20	E-B Model "Q", E-B Model "AA", Emerson Farm Tractor	C	D	H	C	D	H
		E-B Road Maintainer	D	D	M	†	†	†
	40-65, 16-32	E-B (Reeves), E-B	B	C	H	B	C	H
Essex Tractor Co.		*Essex	C	D	M	C	D	M
Farm Horse Traction Wks.	18-30	Farm Horse	C	C	H	B	C	H
Farquhar A. B. Co., Ltd.	15-25, 18-35, 25-50	*Farquhar, *4-30, *4-40	C	D	H	B	C	H
Ford Motor Co.	18	Fordson	C	D	H	C	C	H
Four Drive Tractors, Ltd.	20-35	Standard Model "D"	C	C	H	B	C	H
Fox River Tractor Co.	20-40	Fox	C	D	H	B	C	H
Frick Co.	12-20, 15-28	Frick	C	D	H	C	C	H
General Ordnance Co.	14-28	*G-O	C	D	H	B	C	H
General Tractors, Inc.		Monarch	C	D	H	C	D	H
Gilson Mfg. Co.	14-10	Bolens (Garden)	D	D	M	D	D	M
Graham Bros.		*Graham	C	D	H	C	C	H
Gray Tractor Co., Inc.	22-40	Gray Canadian Special	C	C	H	B	C	H
Gray Tractor Co., Inc.	20-36	Gray 1922	C	D	M	†	†	†
Great Western Motors Inc.		Fageol	C	D	H	C	D	H
Great Western Trac. Co.		Great Western Sr.	B	C	H	B	C	H
Hadfield-Penfield Steel Co.	25-40		C	C	H	B	C	H

† Does not burn kerosene. ‡ Does not burn gasoline. NOTE: "Frost" means approximately 35 to 45 deg. F. "Very Cold" means below Zero to 10 deg. F. * Indicates manufacture discontinued.

LUBRICATION

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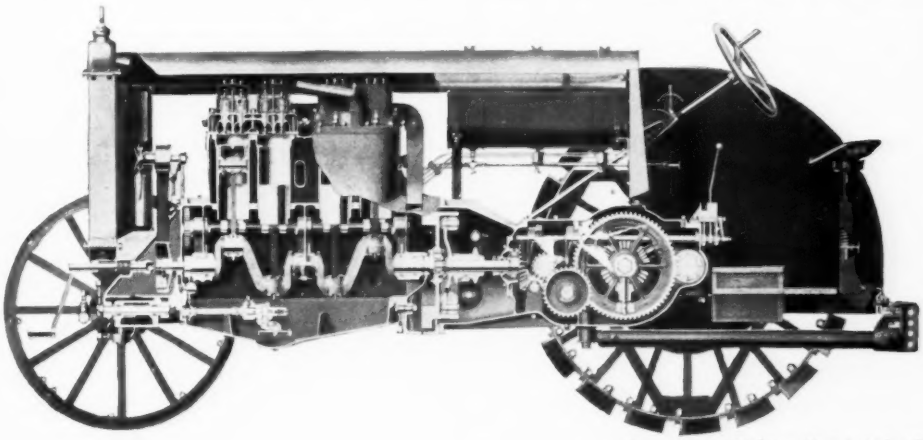


Courtesy Allis-Chalmers Manufacturing Co.

Fig. 1.—Sectional (side) elevation of a modern gas tractor showing engine and transmission details.

The Tractor and its Lubrication

THE extension of the modern tractor to industry as a whole, has been one of the outstanding features of twentieth century engineering progress. In fact, the tractor has become a veritable necessity to modern civilization. In the city, for example, it plays a most important part in street construction, the beautification of our parks, and the removal of snow; on the farm, in turn, it has been preeminently responsible for the extensive adoption of multiple or heavy duty equipment known as power farming machinery *

Tractor duty is heavy. In fact over a period of eight hours continuous operation the work done by the average tractor engine running at full load, at a speed of three miles per hour will be approximately the same as that done by an automobile engine of like horsepower, running at the rate of forty-five miles per hour. In this case the tractor would cover twenty-four miles, the automobile three hundred and sixty miles.

Under such intensive operation it is the consensus of opinion that lubrication is, without a doubt, the most salient feature involved in tractor maintenance. Load and speed conditions are so intensive, so continuous, so exacting, that the slightest defect in the lubricating system, the use of an improperly refined lubricant, or one unsuited to the service will foster trouble. Eminent engineers have estimated

*See Lubrication of Power Farming Machinery, Lubrication, July, 1923.

that faulty lubrication is responsible for approximately three-quarters of the tractor difficulties encountered today.

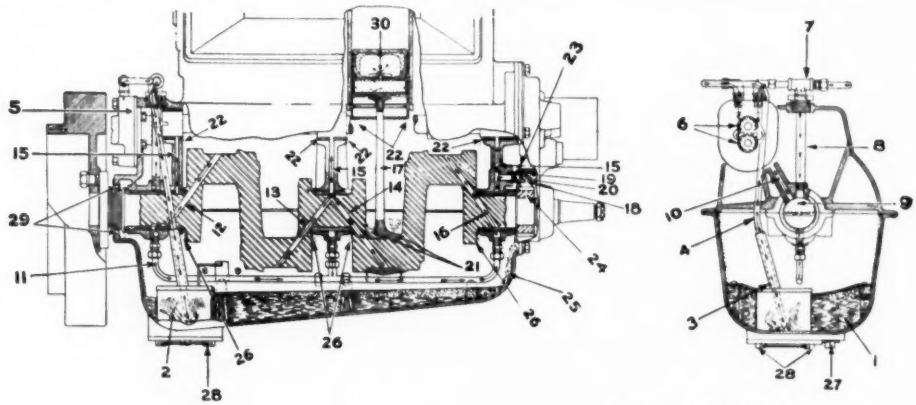
Many tractor users are still but half-hearted converts to the importance of lubrication. The memory of the horse and his method of upkeep and operation is uppermost in their thoughts; as a result the tractor suffers. Lubrication never was given any too much consideration when Dad drove the hay-cart or mowing machine down on the farm. If the team got "three squares" of hay and oats per day, and a currying once a week, all was well. Meantime the farm equipment reposed under the shade of the old apple tree, immune to the oil can, but certainly subject to considerable condemnation whenever the wheels squeaked or parts wore out.

In a like manner some of us attempt to run our tractors today. We think if we fill up with fuel and oil every so often, that is enough, until something goes wrong, then the tractor builder becomes the goat,—or perhaps the oil salesman gets a call interspersed with numerous uncomplimentary adjectives.

But tractor operation is not a difficult matter. We don't require a college degree to oil one, or to keep it running efficiently and successfully. Nor do we need to be oil experts or mechanical wizards. Rather,—what more of us need is good normal common sense.

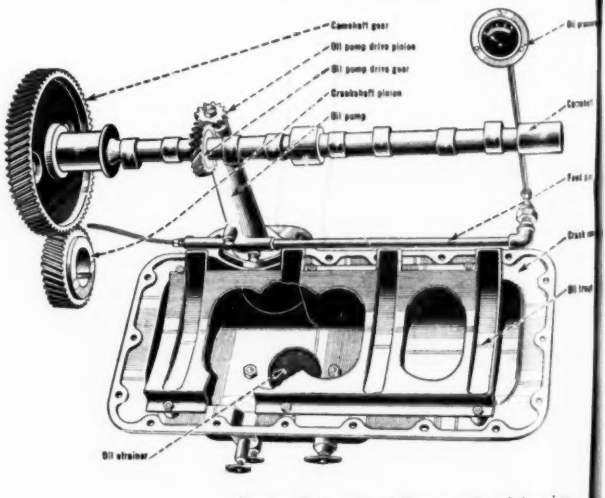
We must appreciate that successful tract operation is chiefly based on successful lubr cation. The horse has no visible wearing part —he is his own lubricator. But the moder tractor is a combination of a multitude of wea ing parts; some of these we can see, others ar concealed. But they all require lubricatio which cannot be a haphazard swinging of an swab, as we used perhaps to oil the surre axles. It must be in most cases a regular continuous application of the lubricant to t wearing parts during the entire period t tractor is in motion.

Tractor builders have, therefore, made ever effort to so design their machines that lubric



Courtesy The Cleveland Tractor Co.

Fig. 2.—Sectional views of a tractor engine showing direction of oil flow through the oiling system. No. 1, Oil in sump of oil pan; 2, Oil Strainer; 3, Cover and Tube placed on top of oil strainer; 4, Oil Suction Pipe; 5, Oil Pump Body; 6, Oil Pump Gears; 7, Oil Pump delivery tube assembly; 8, Oil pump delivery channel in Motor body; 11, Three-way oil equalization pipe assembly; 18, Oil relief valve assembly; 19, Oil relief spring; 20, Oil relief ball; 27, Plug to drain oil from oil pan.



Courtesy International Harvester Co. of America

Fig. 3.—Details of crankcase pan in one type of tractor showing oil pump, test cocks, pressure gauge, etc.

tion of all wearing parts can be effectively maintained with the least amount of attention on the part of the operator. Likewise, the reputable oil concerns have done their part in developing tractor lubricants which will be suited to every type of machine and practically every phase of operation. The way has therefore been blazed for the tractor owner, and his course should be comparatively easy if he heeds the recommendations of his oil man and the builder of his machine. It is not a difficult matter to lubricate a tractor. Indeed, it should not give any more concern than the lubrication of the family flivver, provided we realize the severity of its service, give it a proportional amount of care and attention and purchase grades of lubricants that are refined to stand up under the most abnormal conditions.

The Tractor Engine

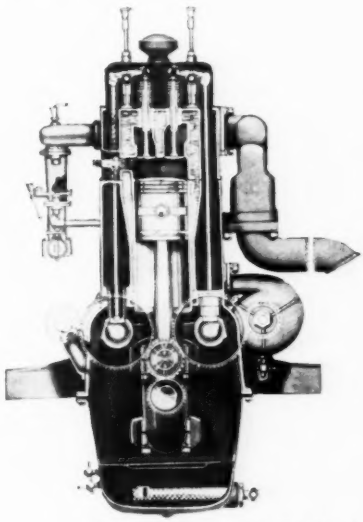
TRACTOR OIL REQUIREMENTS

In order to select tractor lubricants which will insure continuous and efficient operation, we should have a clear understanding of the requirements which they must satisfy. From a theoretical point of view, the engine will be the most difficult part of the machine to lubricate, though manually, it will probably be the easiest. For this reason, the operator will often fail to appreciate the extreme importance of proper engine lubrication.

The intensive duty so often imposed however, places very exacting requirements upon both the oil and lubricating system. Realizing this, the Oil Refiner has carried on extensive research and refining investigations to prove that it is possible to refine lubricants from petroleum, which will meet working conditions, however exacting, and conform to tractor engine construction, however intricate.

The Tractor Operator of course has no practical means of checking the suitability of his oil, or its ability to assist in the development of most effective lubrication in his particular tractor. He must take somebody's word for this, and perferably it should be the Tractor Builder's, for the latter should have tested the various grades of tractor oils on the market in cooperation with the Oil Refiners, and recommend those found best suited to the constructional features of his engine.

On the other hand, the progressive operator will want to know what the requirements of a good tractor oil are so that he can discuss these points with his oil dealer intelligently and to his own advantage. Therefore he will be interested in:



Courtesy Minneapolis Steel & Machinery Co.

Fig. 4.—End view of a tractor engine, showing constructional details.

1. Its lubricating qualities, or in other words, whether the oil will be able to form and maintain a suitable lubricating film between all wearing surfaces. Only thereby can we insure against metallic friction, scoring of cylinders and ultimate burning out of bearings.

2. The extent to which the oil will withstand heat. A good tractor engine oil should be capable of working under the usual higher temperatures of operation without burning to hard carbon, excessive loss in viscosity, or decomposition.

3. The seal forming properties. A satisfactory engine oil must form a sufficient seal between the cylinder walls and piston rings to prevent leakage and loss of compression.

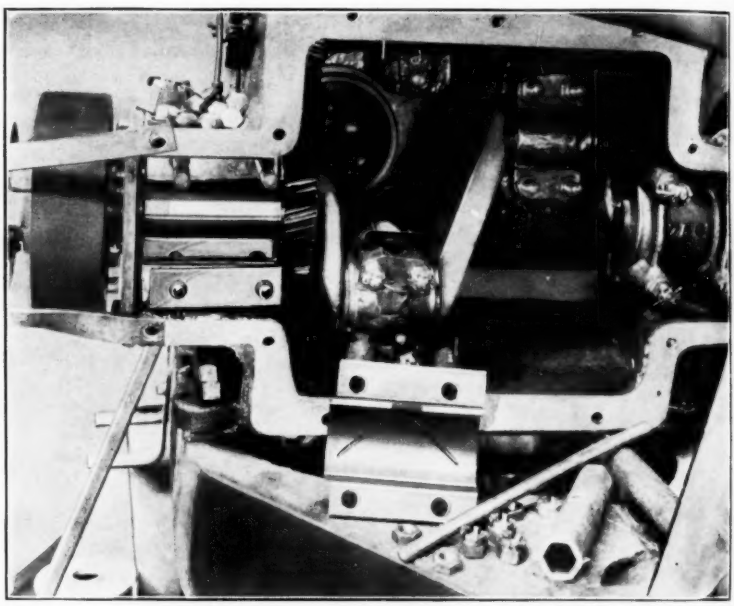
4. Whether the oil has sufficient body to resist being squeezed out from between any of the wearing parts, such as crankshaft and piston pin bearings, where pressures are relatively high.

5. The action of the oil in cold weather. It should always possess a low pour test in order

to have sufficient fluidity to flow readily throughout the oiling system, whenever it might be desired to use the tractor in winter. Otherwise, certain of the bearings will suffer from lack of lubrication.

6. The extent to which internal or molecular friction is developed. Naturally friction of this nature, which occurs between the particles of the oil which compose the lubricating film, should be as low as possible to avoid excessive power consumption in overcoming it.

Of course every Tractor Builder should have determined the extent to which every grade of oil he recommends will meet the above requirements. It would be relatively impossible for the operator himself to make any very practical experiments for his own satisfaction. In fact, that would scarcely be necessary for, in reality, a knowledge of the basic oil requirements is all he needs to prove to either his Tractor Builder or oil dealer that he knows what he wants. He can then make them prove to him in turn, the reasons why any particular grade of oil will be better than another.



Courtesy Hart-Parr Company

Fig. 5.—Illustration of main bearing details on a modern tractor, showing the necessary parts, etc.

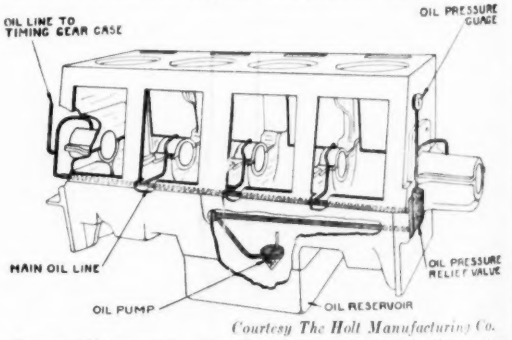
HOW TO SELECT TRACTOR OILS, ETC.

The choice of the correct oil, from the viewpoint of the operator, for any type of tractor will involve two general conditions, *i.e.:*

1. How the oil will act on starting in cold weather, or, in other words, whether its pour test is sufficiently low to insure effective flow to all parts of a cold engine or lubricator pump without abnormal internal friction and

2. What its condition will be under operation. This latter is a question of viscosity or body.

It is perfectly evident that the oil must fulfill both of these requirements, otherwise it will be unsatisfactory. Even perfect suitability in either one case or the other, does not recommend its usage in any but exceptional instances, as ultimately trouble will be apt to occur. On the other hand we must temper this consideration with good judgment in certain instances. For example, where mechanical force feed lubricators are used in cold weather on larger types of engines, an oil must be chosen which, when cold, will be sufficiently fluid to be drawn readily into the pump units. Yet a somewhat heavier oil might possibly be theoretically better if we were to consider engine conditions only.



Courtesy The Holt Manufacturing Co.

Fig. 6.—Diagrammatic view of a tractor engine lubricating system showing oil lines, etc.

Therefore, the selection of a tractor oil will essentially be influenced by:

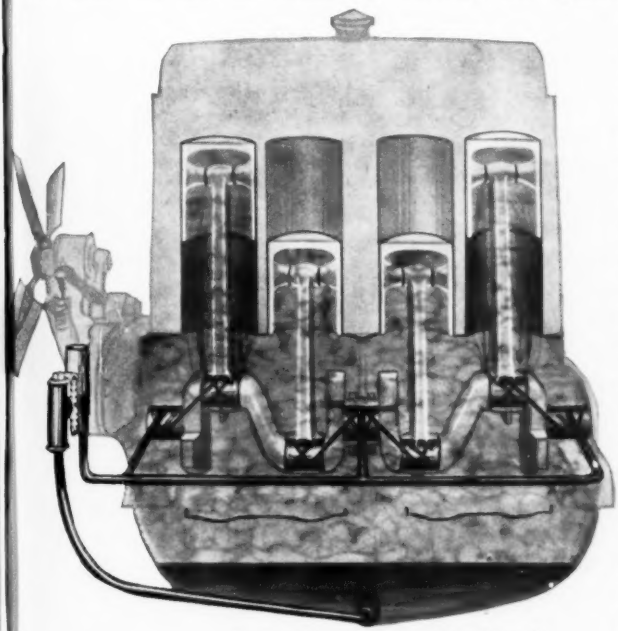
(a) The engine,

(b) The lubricating system and

(c) The operating conditions that must be met.

Engine Conditions

The beneficial results that efficient lubrication of a tractor engine will lead to, are certainly the most interesting and vivid recommendations for the careful selection of tractor oils. They are what we are all ultimately striving for whether our tractor plows snow in New York City or operates a harvester, etc. in Kansas when the temperature is 100° in the shade and "there ain't no shade". In brief, we want:



Courtesy Minneapolis Steel & Machinery Co.

Fig. 7.—Side view in phantom of a four cylinder tractor engine showing oil piping.

1. *Maximum Power*, attainable only by the use of a tractor engine oil which will not carbonize in the combustion chamber, on the piston head, valves or around piston rings, etc. Hard carbon deposits on valves or seats will cause loss of compression due to uneven seating of the valves. In the combustion chamber such deposits will cause detonation and even pre-ignition. Similar deposits around piston rings or wedged in the grooves will cause sticking of the rings and as a result they will not function properly nor maintain a suitable seal between the piston and cylinder walls. Loss of power and compression will be the direct result.

Free movement of the piston rings is the secret of maximum power development in any tractor engine. Their purpose is to compensate for the more or less uneven clearance which must exist between the piston and cylinder, thus forestalling sticking or seizing of the piston under the relatively high temperatures of operation. As the age of the engine increases, this clearance will be increased due to wear. If the piston rings work freely, and the oil film is of suitable thickness, the clearance will be practically compensated for and little or no loss in compression will result. But, a set of sluggish rings due to formation of hard carbon deposits in the piston grooves will immediately cause a certain loss in compression, unless perhaps the oil film is sufficiently thick to fill up the clearance space.

Therefore, it is advisable to always make sure that you are using an oil which will not cause hard carbon deposits. In effect, select a product which will be distilled off entirely into vaporous matter at the higher temperatures of operation, or develop but light fluffy carbon formations which can be blown out by the exhaust. Your Tractor Builder should have tested the oils of all reputable refiners to determine this for you, and many have done so. Where this has been carried out thoroughly, you are safe in taking the Tractor Builder's recommendations. Many Oil Refiners have also made such investigations. In fact, they are often in better position to make lubrication recommendations more intelligently and completely.

2. *A Minimum of Crankcase Dilution;* this is to insure economy in the use of oil, and prevent abnormal wear of bearings due to extreme reductions in viscosity. Generally speaking, crankcase dilution, or the dilution of the engine oil by the fuel, will occur more readily in an engine burning kerosene than one using gasoline. From a gasoline engine viewpoint this subject has been discussed in detail in LUBRICATION for September, 1923, in an article on "Why Automobile Oils Must Be Periodically Changed". The same discussion will apply to the kerosene engine but we must remember that vaporization of kerosene is very apt to be less complete, and therefore crankcase dilution will be more rapid. On the other hand, the fact that dilution has occurred is no indication that the lubricating value of the oil has been

lowered. This matter was treated in detail in the above article.

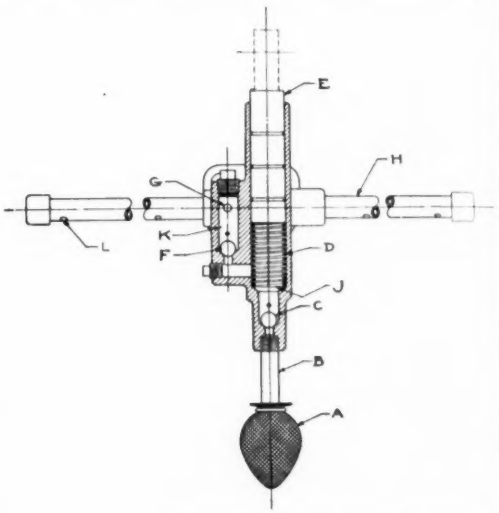
Many of the tractors today use kerosene as fuel for reasons of economy, although they require gasoline for starting. Kerosene will usually not burn as completely as gasoline due to the presence of more or less so-called heavy ends or fractions of low volatility which remain unvaporized. Of course, under higher engine temperatures more of these hydrocarbon fractions will be vaporized and burned during the combustion stroke. This will never occur to completion, however, and a certain amount of fuel will always find its way into the crankcase either by leakage past the piston rings or by being absorbed by the film of lubricant on the cylinder walls. Either is a direct cause of dilution of the oil in the crankcase, and this is progressive up to a certain point where the viscosity of the oil will have reached a state of equilibrium, depending upon the operating temperature of the engine.

Courtesy J. I. Case Threshing Machine Co.

Fig. 8.—An oil level gauge is an important piece of equipment on the tractor engine. A cork float in this case operates the gauge which indicates the height of oil in the reservoir at all times.

To a certain extent the possibility of crankcase dilution would seem to be lower in a tractor engine than in the average automobile engine on account of the fact that higher operating temperatures are involved. The lower volatility of kerosene however, usually defeats this possibility. In fact, instances are known where kerosene entered the crankcase faster than the oil was consumed, overflows being necessary to prevent the accumulation of too much of this mixture in the crankcase.

It is a simple matter to make a rough test on dilution by drawing off a sample of oil from the crankcase into a bottle and comparing it with a similar bottle full of fresh oil, being sure that both are at the same temperature. By rapidly and simultaneously inverting both bottles, the relative rise of air bubbles will indicate whether the used oil has been diluted to any extent. The more rapidly the bubbles in the latter sample rise, as compared with those in the fresh oil, the lower will be its viscosity.



Courtesy Emerson-Brantingham Implement Co.

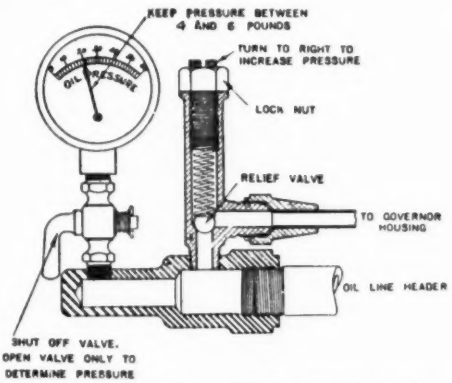
Fig. 9.—A Tractor Oil Pump of the plunger type. "E" is the plunger; "F", the check valve; "H", the oil pipe; "G", the oil inlet.

3. *The Utmost Fuel Economy.* This will be directly related to the matter of compression and crankcase dilution. If compression is poor and the valves and piston rings are not at fault, that is, if the lubricating film on the cylinder walls is not furnishing the requisite seal due to use of an oil which is unable to withstand the pressure of compression and explosion, or if carbon formations are interfering with the free action of the piston rings, a certain amount of the charge will blow past the piston on the compression stroke, as will also some of the gases during the combustion stroke. Blow-by of this nature will lead directly to crankcase dilution and of course, loss of fuel, for the fuel that enters the crankcase and dilutes the oil has little or no further opportunity of producing power.

As crankcase dilution continues, additional power may be consumed especially if bearings or other wearing parts become under-lubricated due to abnormal reduction in viscosity, and metal to metal contact occurs.

Valve and piston ring adjustments are assumed as being correct simply for the purpose

of bringing out the other factors involved. These are mechanical details which will usually be maintained in proper operating condition by the progressive tractor owner.



Courtesy J. I. Case Threshing Machine Co.

Fig. 10.—A typical oil pressure gauge which indicates the pressure at which oil is fed to engine bearings.

To a certain extent, a lack of power, suitable compression and fuel economy, or an excess of crankcase dilution, will be manifested to the tractor owner over long-run operation, both by the productive ability of his machine, and his fuel and lubricating oil bills. In fact it is not a relatively difficult matter to carry on comparative running tests on any number of grades of oil, by simply taking proper records of fuel and oil consumption, mileage covered, (over of course, similar territory), and making regular inspections of the cylinder head, piston and valves for carbonization. Provided operating conditions are maintained as nearly alike as possible and the crankcase or lubricating system is properly cleaned and drained with a suitable light engine slushing oil prior to the introduction of any new or different grade of tractor engine oil, any records as specified above can be relied upon to give a good comparison of the relative ability of any number of oils to meet the requirements outlined.

The Lubricating System

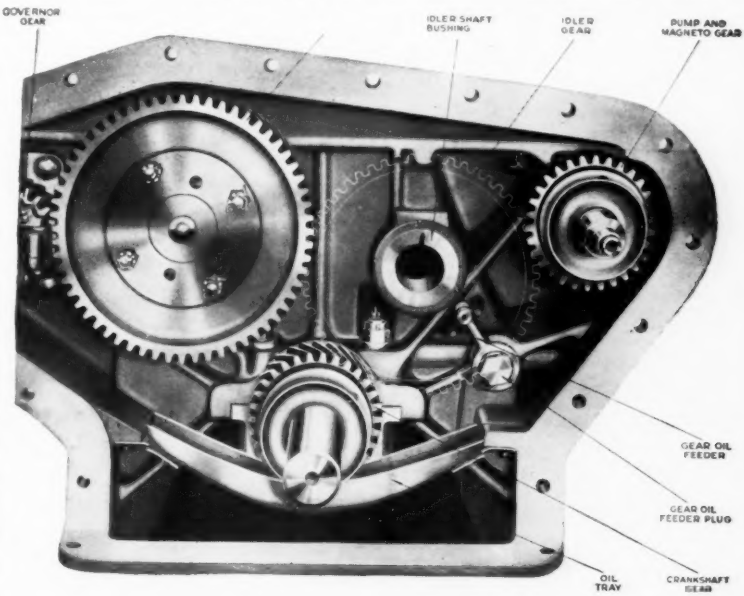
The above discussion of engine conditions which lays so much stress on compression, piston ring seal and crankcase dilution naturally leads up to the query: Why not so design the oiling system as to obviate the losses involved as much as possible?

This is just what automotive specialists throughout the world have been striving to do. As a result the mechanical force-feed lubricator, the circulating splash system and the full pressure method of lubrication have all been used, including even certain of their combinations.

Mechanical Force-Feed Lubricators

External mechanical force-feed lubricators which are designed to feed fresh oil drop-by-drop to the cylinders and main bearings, have been used more or less extensively in tractor practice for many years.

Mechanical force-feed lubricators get around the difficulty of crankcase dilution by furnishing a supply of fresh oil constantly to each bearing and cylinder via individual plunger pumps and oil ducts. This method of lubrication is very similar to that so commonly employed on many types of reciprocating steam engines, etc.



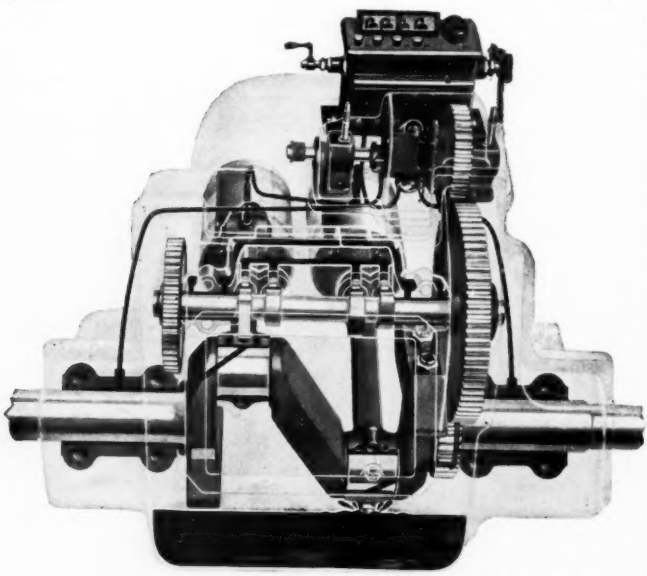
Courtesy The Holt Manufacturing Co.

Fig. 11.—Timing gear case of a Tractor showing method of lubrication. Oil is delivered through a special feeder.

today. The oil flow is absolutely controlled in its intensity, as well as in its starting and stopping by the engine, since the lubricator pumps are driven directly by the latter.

The mechanical lubricator is usually provided with a crank by which fresh oil can be pumped to the bearings by hand when the engine is not running. This should always be done prior to starting in order to insure that sufficient oil will have reached the bearings to maintain lubrication until the engine has put the lubricator pumps in operation.

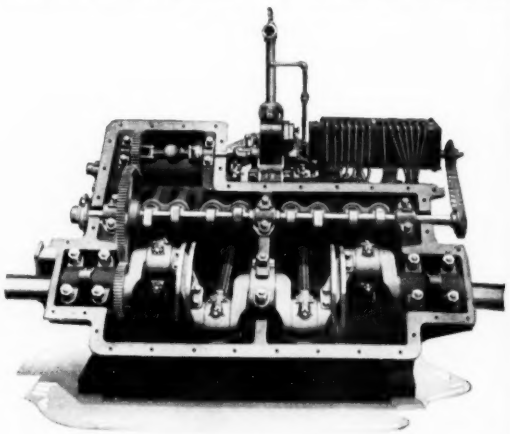
The question of oil flow or travel through exposed piping in cold weather is often raised when considering the proper viscosity for winter service. The travel of oil through such exposed piping however, as the mechanical lubricator will involve, does not depend on viscosity. An efficient oil pump will even force grease through such piping against pressures of approximately 1,000 lbs. per square inch. It is the drawing in or suction of the oil into the pump chambers which involves the viscosity or fluidity of the oil, as is true of any pump in any type of oiling system,



Courtesy Advance-Rumely Thresher Co., Inc.

Fig. 12.—Lubrication details of a two cylinder tractor engine using a Madison-Kipp force-feed lubricator. Oil travel can be clearly traced.

The advantage claimed for the external mechanical force-feed lubricator, is that a regular, predetermined supply of clean fresh oil, free from fuel contamination and dust, is furnished to all cylinders and bearings. As a result the injurious effects of crankcase dilution are eliminated since the oil which drains from these wearing parts is not used again as an engine lubricant. Oftentimes it is used, however, for



Courtesy Advance-Rumely Thresher Co., Inc.

Fig. 13.—A four cylinder tractor motor with cover removed showing a mechanical force feed lubricator oil pump in upper right hand corner.

rough machine lubrication as on gearing, etc. Otherwise it is thrown away. The question is frequently raised as to whether this procedure is more wasteful than the discarding of the entire contents of the crankcase every few days when a splash or internal force feed system is employed. The answer is of course, "Yes and No", with certain provisos. In event of use of a suitable oil in an engine where crankcase dilution is not excessive, more oil might be wasted by the external mechanical lubricator. On the other hand, the reverse may also often be true where the operator is careless, crankcase dilution excessive, or a low grade of fuel used entailing much priming and the firing of a rich mixture.

Yet, oftentimes a cheaper oil can be used in the mechanical lubricator, since excess can be guarded against and oil is used but once.

Circulating Oiling Systems

Circulating full pressure force-feed, or splash oiling systems are installed by many tractor builders. In effect, an effort is being made to standardize tractor construction in the same manner as the automobile has been standard-

ized; hence the tendency of many builders to use methods of lubrication which have been proven adaptable to the automobile engine up to the present time.

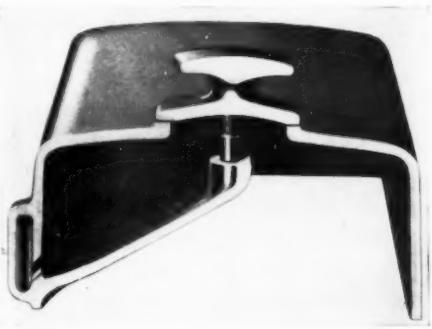
The full pressure system of lubrication is preferred by many in view of the fact that a sufficient amount of oil is assured to all moving parts when the engine is running, and no oil is wasted or discarded until its lubricating value has been so reduced as to render it worthless.

Operating Conditions that Must Be Met

Where operating conditions are being considered we must take into account certain definite physical characteristics of our tractor oil, such as:

a. Carbonization.
b. Viscosity.
c. Pour test.

Carbon formation is probably the most effective guide in the prediction of an oil's utility



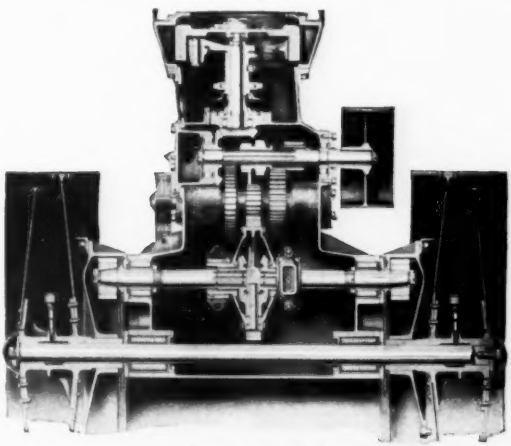
Courtesy J. I. Case Plow Works Co.

Fig. 14.—Sectional view of an air cleaning device in the cylinder head of a tractor.

under continued operation. We have already spoken briefly of the power-reducing effects of hard carbon accumulations in the combustion chamber or on the piston heads, valves and valve seats. Therefore every endeavor must be made to obtain an oil which shows as low a carbon residue test as possible, since this is indicative of clean burning, and any carbon that does result should be of a light fluffy nature.

In further connection with this matter of carbonization, some form of air cleaner should be installed on every tractor through which the necessary air for combustion can be drawn and purified prior to entering the carburetor. There is considerably more dust and dirt stirred up where a tractor is used, than in average automobile service, and if the air cleaner is not operating satisfactorily to remove this dust, trouble will be bound to occur due to accumulations of such foreign matter along with any carbon that may result from either the oil or fuel during operation.

In selecting tractor oils the operating conditions that will be involved also require consideration of the viscosity and pour test. We must remember that the majority of the year's operation takes place in the Spring and Autumn when it will often be necessary to start the engine under temperatures in the neighborhood of freezing. Here, a sufficiently light bodied oil must be used in order to have available the requisite viscosity to insure immediate flow to the bearings when the engine is started. As an aid in this connection recommendations stated on the inside covers of this issue are given. Seal may be sacrificed to a slight degree, with a consequent reduction in compression, some fuel loss, and crankcase dilution, especially when kerosene is used immediately after starting. But lubrication will be insured, and this is, after all, the purpose for which the oil is used.

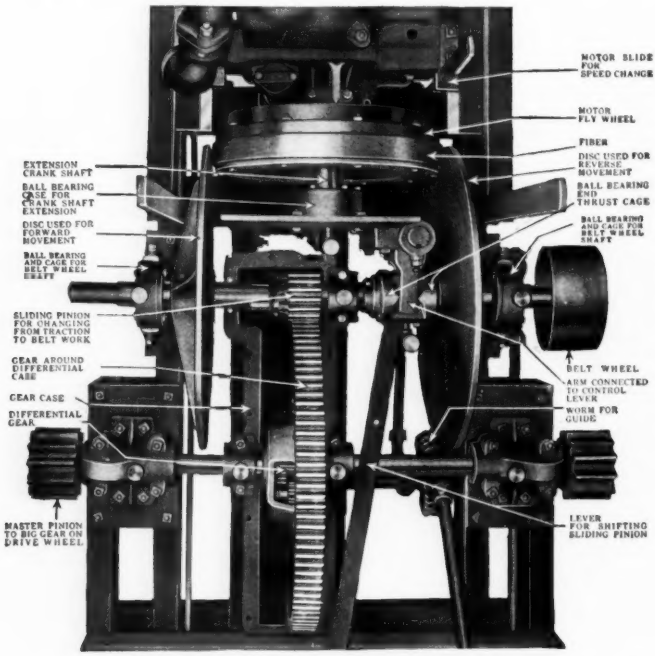


Courtesy Allis-Chalmers Manufacturing Co.

Fig. 15.—Sectional view of a tractor transmission wherein ball bearings, roller bearings, and plain babbitted bearings are involved.

Again, during the summer months the tractor will often operate in the intense heat of the sun at continual full load with cooling water at an abnormally high temperature; or, when the tractor is used for threshing, the engine will

operate at a standstill and the cooling capacity of the radiator will be somewhat lower. High engine temperatures improve combustion of the fuel, and as a result, crankcase dilution may be reduced to a certain extent. Hence a lighter oil may function properly even in the face of perhaps a certain amount of reduced viscosity. On the other hand, the possibility of an insufficient film of oil on the major bearings will warrant a certain increase in viscosity over that recommended for cold weather service. Large piston diameters, high clearances, or slow piston travel, will always call for somewhat heavier oils.



Courtesy Rock Island Plow Co.

Fig. 16.—Details of a type of friction transmission and differential which makes it possible to attain 7 speeds forward or reverse.

The Transmission and Final Drive

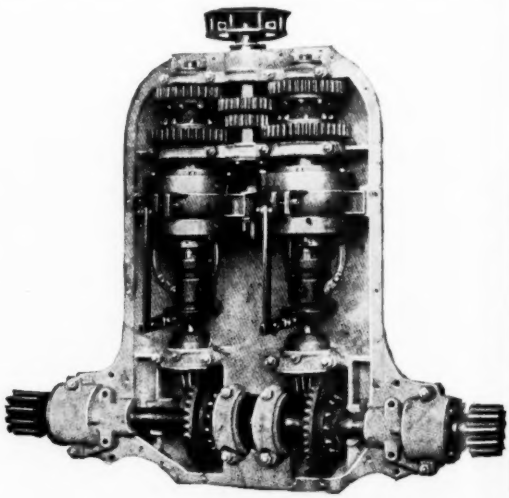
The tractor transmission is located between the engine and the differential, the same as in the automobile. Its function is to transmit the power developed by the former, through a set of sliding spur gears or some other form of speed changing device, to the final drive which impells the rear wheels or track element.

Transmission lubrication is essentially a matter of combined gear and bearing lubrication wherein the lubricant must serve a dual purpose. In the majority of tractors today, the transmission is enclosed in an oil tight casing and bath lubrication is made possible.

Power is usually transmitted through two distinct gear reductions, when the tractor is in motion, and the service on these gears is very severe. So a gear lubricant must be used that will protect the teeth from wear and reduce noise during operation.

On the other hand, the body or viscosity of this lubricant must often be modified to conform to the requirements of the bearings. Where roller or ball bearings are installed a straight mineral product of about 200 sec. Saybolt at 210° Fahr. will function admirably. On plain bearings, however, where the lubricant must work its way through oil grooves a lighter grade should be used. Certain Builders recommend a soap thickened transmission lubricant, whereas others have found a heavy bodied tractor engine oil most suitable.

Where using heavier gear lubricants, the gear case should never contain more than just



Courtesy Yuba Manufacturing Co.

Fig. 17.—Transmission case of a tractor exposed. Note clutch and gear arrangements.

enough to insure that the teeth of all gears on the lowest shaft of the transmission will dip in the lubricant. This will promote the most effective lubrication; any increase in the amount of compound in the case will impose a drag on the gears, especially in colder weather. Where slow motion is involved, however, certain authorities disregard "Drag" and recommend that the level of the lubricant be raised until certain of the higher gears are submerged.

The pour test of transmission gear lubricants is especially important when the tractor is to be used in cold weather. Even a properly filled gear case cannot insure us, if our gear lubricant has not a sufficiently low pour test to remain fluid under low temperature operation. In such an event the gears would channel through it, and any lubricant sticking to the sides of the case would not flow readily back to the bottom. The evident precaution is to select a gear lubricant which will have a pour test at least as low as the average operating temperature which will be encountered in cold weather.

Where the transmission is not enclosed a lubricant must be used which will stick tenaciously to the gear teeth and not be thrown off by centrifugal force or affected by water. For this purpose a heavy bodied straight mineral gear compound of about 2000 sec. Saybolt viscosity at 210° Fahr. should be used.

Bearings in such gear arrangements are generally lubricated independently by means of compression grease cups; a medium body compression cup grease will function properly in cases of this nature.

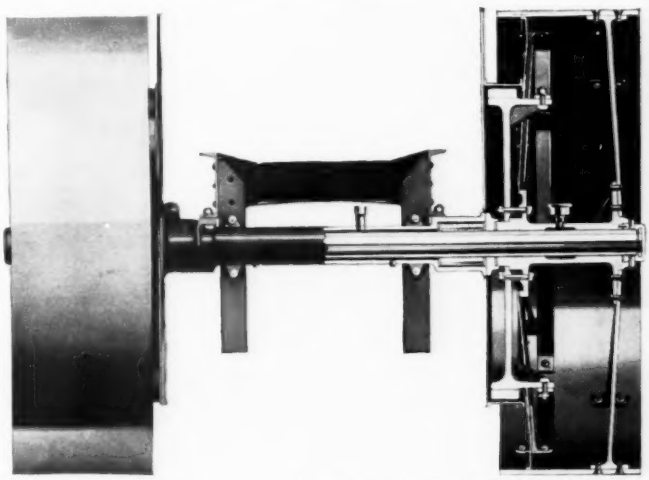
The Final Drive

While the final drive and differential may include spur gears, internal gears, chains, worm or bevel gears, according to the design of the machine, the spur gear predominates today.

In the majority of cases the chains or gears operate exposed, and it is necessary to use a gear lubricant of at least 2000 sec. Saybolt viscosity to take up the shock and strain so often incurred, which would squeeze any lighter lubricant out from between the gear or sprocket teeth. Wear and deterioration will be bound to occur through the use of lighter oils or greases, as these would only drip off prematurely.

In driving chain lubrication the lubricant must again serve a dual purpose, i.e.

1. As a lubricant, and
2. As a protective agent.



Courtesy Advance-Rumely Thresher Co., Inc.

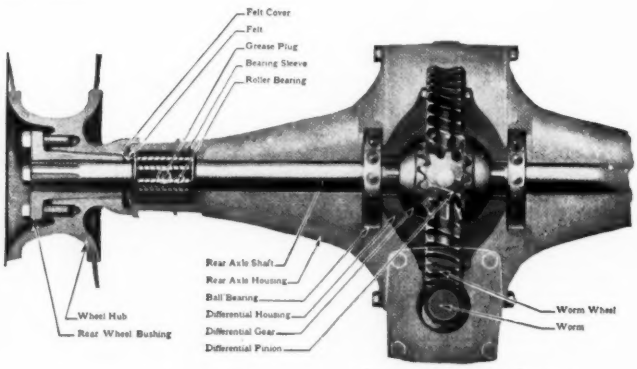
Fig. 18. Sectional view of a tractor rear axle showing bearing details and methods of lubrication.

Therefore, every care must be taken to thoroughly saturate the chain links and insure the lubricant penetrating to the innermost wearing parts. For this purpose a straight mineral lubricant having a viscosity of about 1000 sec. Saybolt at 210° Fahr. is best suited. This should be applied hot, preferably by removing the chains and immersing them in a pail filled with the lubricant. They can then be hung up to cool and drain of excess lubricant.

Miscellaneous Lubrication

Tractor link pins, rollers, wheel hubs and other miscellaneous bearings on the modern tractor must also be kept properly lubricated if the machine is to function as an efficient unit. While there is not the necessity for as exacting characteristics in the lubricants as in the engine, etc. we should not go to the other extreme and neglect lubrication of such parts. Compression cup grease, a light gear lubricant, engine oil, or reclaimed oils will function efficiently according to the type of bearing and means of lubrication

available. A periodic inspection of such parts, according to the Builders' recommendations will insure a minimum of wear and a maximum of service.



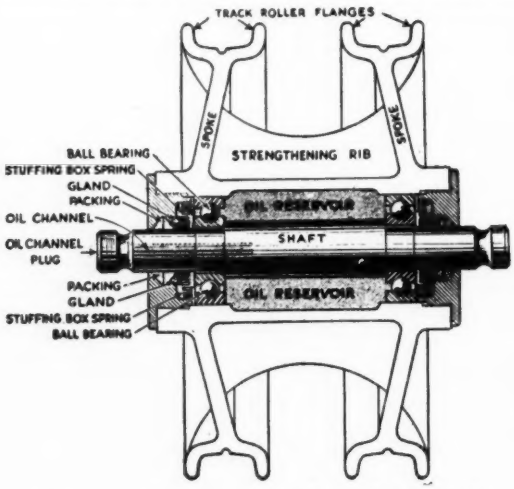
Courtesy Ford Motor Company.

Fig. 19.—A tractor rear axle and wheel assembly showing gear and bearing details. Both ball and roller bearings are used on this machine.

Conclusion

Let's, therefore, get down to the use of a little more common sense in the future lubrication of our tractors.

Forget once and for all that the "only requirements" are catchy ads, a pretty label and vague promises of wonderful results. Maybe an oil so purchased will give excellent service but we don't want to deal with possibilities. Else we should also consider what to do when the tractor stalls in mid-August in the glaring sun, several miles from home, on account of the "best" oil going wrong.



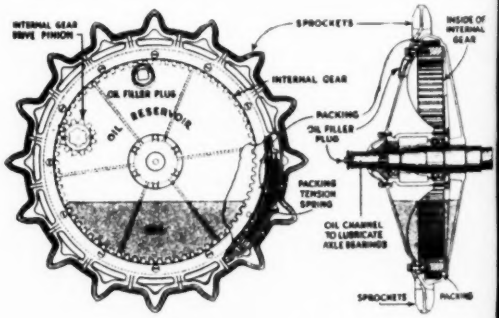
Courtesy Bear Tractors Inc.

Fig. 20.—Front wheel and track roller lubrication details. Reservoir lubrication is a feature in this machine.

Hard service is the essence of tractor operation, and practical experience dictates that for hard service in any field of engineering, effective lubrication must exist, if continuous efficient operation is to be insured.

Any old oil, as long as it is labelled "Tractor Oil", won't do. We wouldn't risk its use were our tractor a pleasure vehicle. The danger of getting stuck somewhere back in the country would be too great. Following the same line of reasoning, we shouldn't use it on the tractor, even though that machine is but a seeming "beast of burden". In fact a tractor out of service during the harvesting season might easily result in almost complete loss of an entire crop.

The natural alternative is to use more care in the selection of the tractor oil; in fact, of every lubricant required by the tractor. Look



Courtesy Bear Tractors Inc.

Fig. 21.—Rear wheel lubricating details where reservoir lubrication is also employed.

into the maker of the oil. Look into the Tractor Builder's recommendations. Look into the requirements your particular machine imposes on the lubricants. Study the requirements that a good tractor oil, for example, should satisfy. Analyze your own particular operating conditions with respect to these requirements; not forgetting to keep in mind that Tractor Builders and Oil Dealers are ready and able to cooperate with you in every respect.

Then purchase your oils, greases and gear compounds and use them with proper discretion. Don't buy first and investigate later. This is as bad as "locking the stable door after the horse is stolen."

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